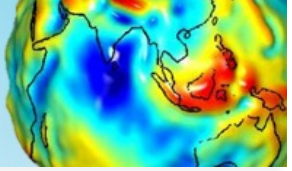
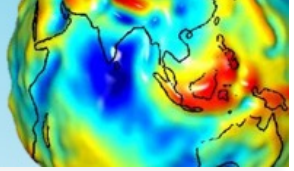
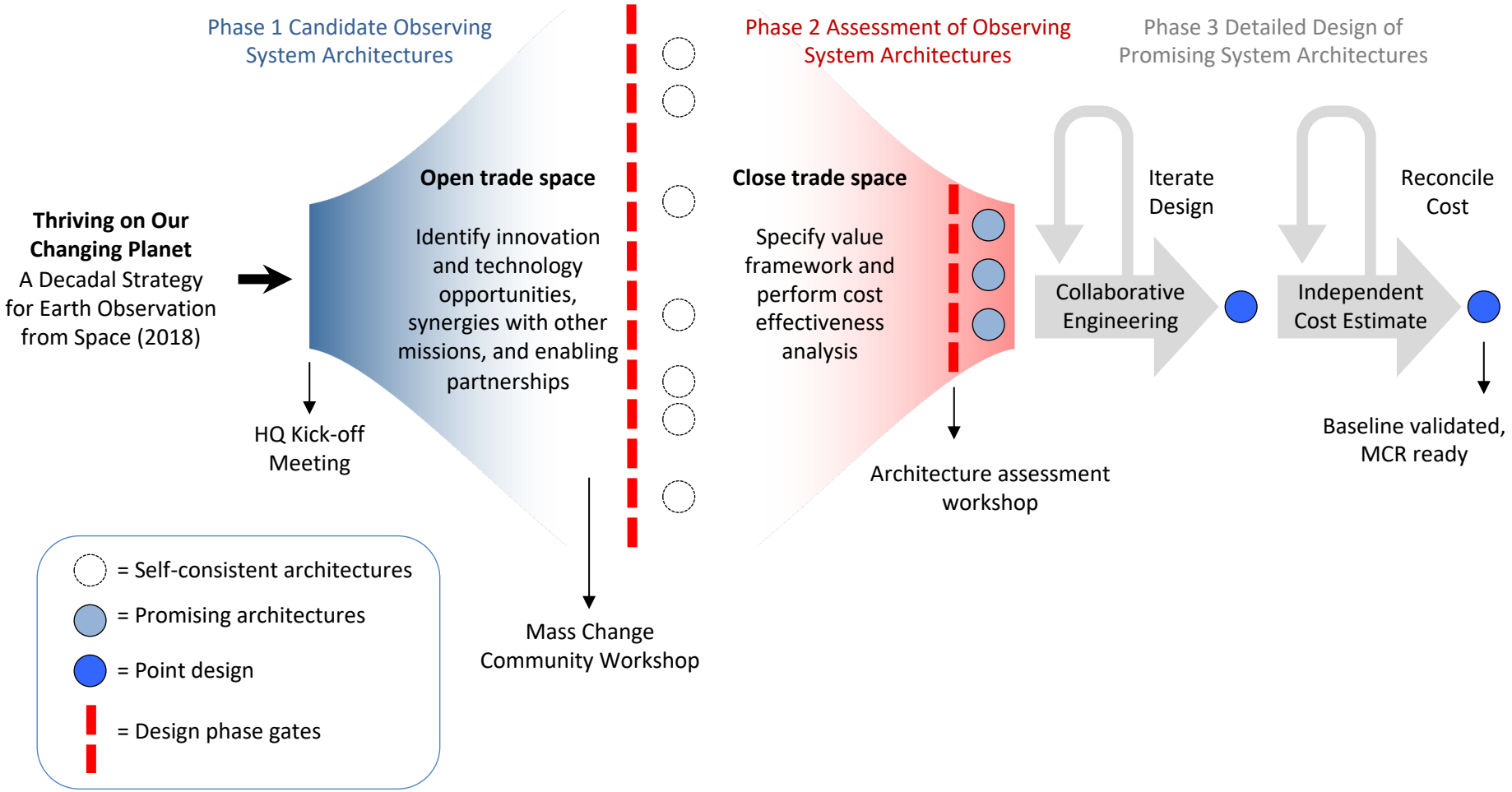


Mass Change Study Path Forward

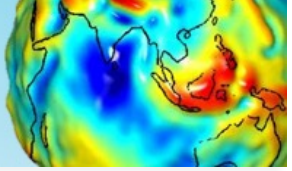
Kelley Case
Jet Propulsion Laboratory, California Institute of Technology
Architecture Formulation Co-Coordinator
August 1, 2019

Study Phases





Study Phase 1
Candidate Observing System Architectures



Identify innovative solutions across a broad architectural trade space

- Identify new gravity measurement approaches and techniques, such as:
  - Gradiometry
  - Low-power, low-mass, high-precision inter-satellite laser ranging
  - Measurement of non-conservative forces using an electrostatic accelerometer versus drift mode accelerometry versus the use of a full or partial drag-compensation system
  - Determine if payloads can fit within small satellite buses
  - Take advantage of multiple pairs of satellites in optimized orbital planes, if partnerships are possible
  - Take advantage of large constellations of satellites with only positioning information and/or low-resolution crosslinks

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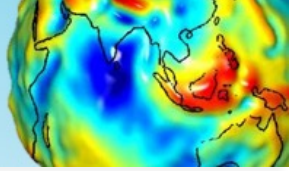
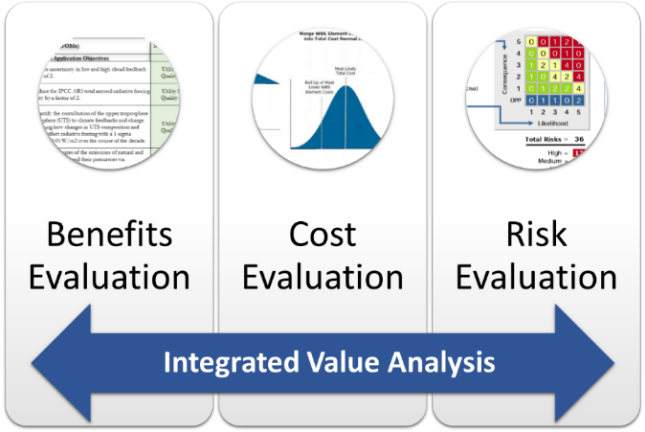
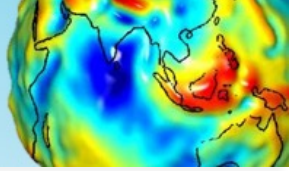
Study Phase 2
Assessment of Observing System Architectures

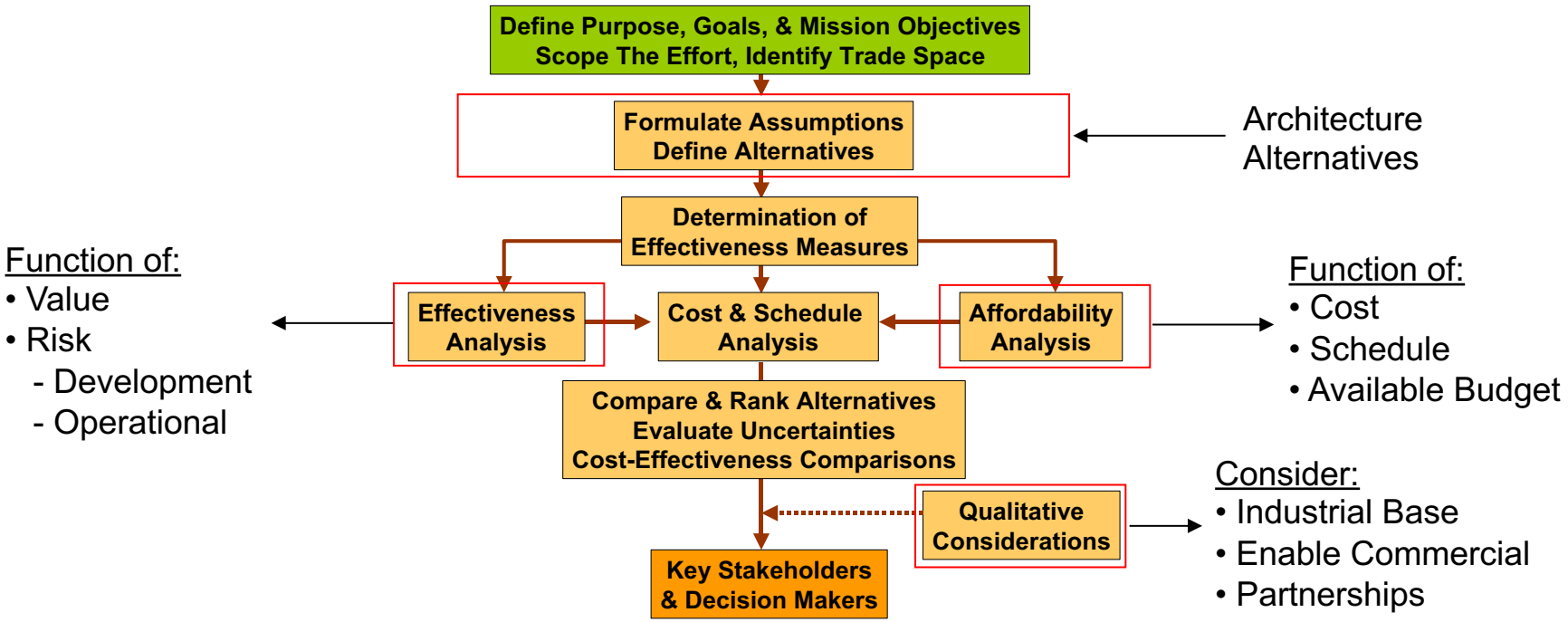


- Assess the set of architectures to aid the decision-making process by illuminating the risk, costs, and relative advantages and disadvantages of the various architectures under consideration.
  - Provide detailed documentation of the analysis of the benefits achieved by each mission architecture.
  - Implement best practices to enable clear, traceable, and repeatable analyses.
  - Facilitate conversations among stakeholders by highlighting key areas of agreement and disagreement, and fosters productive discussions.



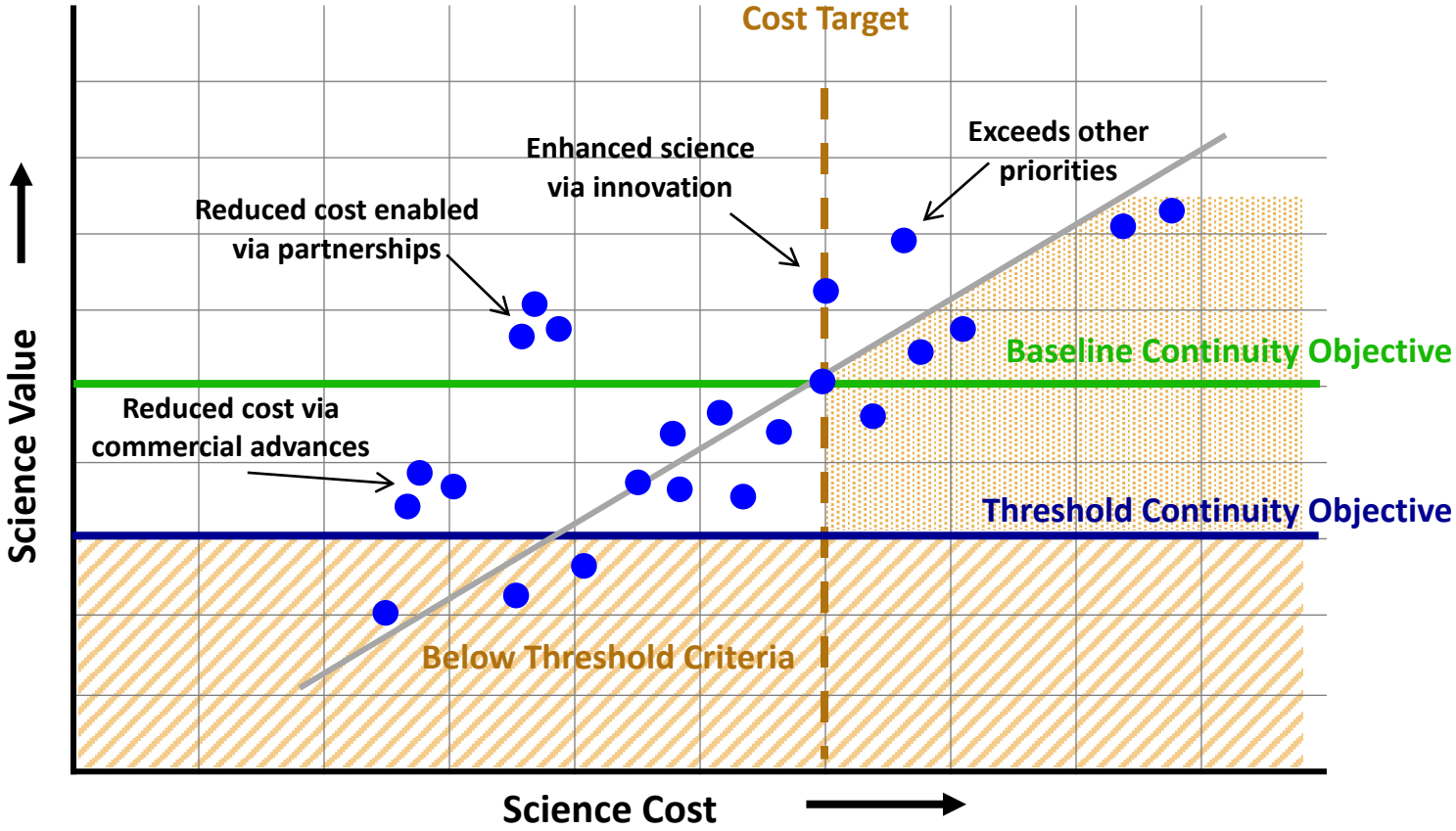
Assessment Process





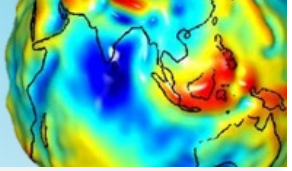
Once a set of system architectures has been identified, a Value Framework will be established. Measures will be defined based on the ESAS 2017 DS to assess the key features relevant to decision criteria while providing the ability to discriminate between alternatives. The alternatives will then be evaluated through a set of analyses covering such assessment areas as capability, cost, schedule, risk, and affordability.

Value Framework



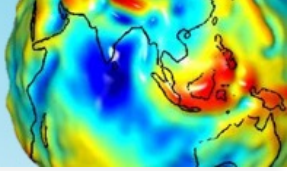
Notional graphic showing Science Value vs. Cost. Gray diagonal line depicts a conventional cost performance profile. Blue dots depict individual architectures. Reduced cost to NASA may be enabled through strategic partnerships and/or innovative opportunities. Enhanced science return may be enabled through new technologies and/ or innovation. Architectures below the Threshold mission or above the cost target will not be considered.

Measure of Value



- Value, if determined by a decision-maker, may be problematic
  - Decision-maker may not commit to a specific value structure
  - There may be multiple decision-makers with different value systems or they may change frequently
- Value should therefore be based on decision-maker **documentation** (decadal objectives, performance/cost targets, etc.)
  - Decadal Survey and SATM serve this function
- Measures of “Science Value” should be:
  - Simple and logical -- Increases chance that choices can be quickly interpreted with minimal explanation
  - Objective in nature -- limit subjective opinions to decrease debate and reduce ability to bias answer
  - Tied to threshold and baseline values -- quantify based on “value bins” of meeting threshold, or meeting baseline, or exceeding baseline
  - Limited in number -- reduce number of measures to minimum that can discriminate between architectures

Next Steps



- Completion of Phase 1 (August - September 2019)
  - Final collection of potential architectures (August 2019)
  - Input to Designated Observable (DO) Annual Review (September 2019)

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- Commence Phase 2 (October 2019 -)
  - Establish Value Framework (October 2019)
  - Performance Evaluation of Architectures (Nov 2019 – Mar 2020)
  - Cost Analysis and Risk Assessment of Architectures (Nov 2019 – Mar 2020)